

Construction . . . of Pianos:

How to Tune and Repair ;
Tools and Materials
Used and Required.



BY
E. A. FOLLETT,

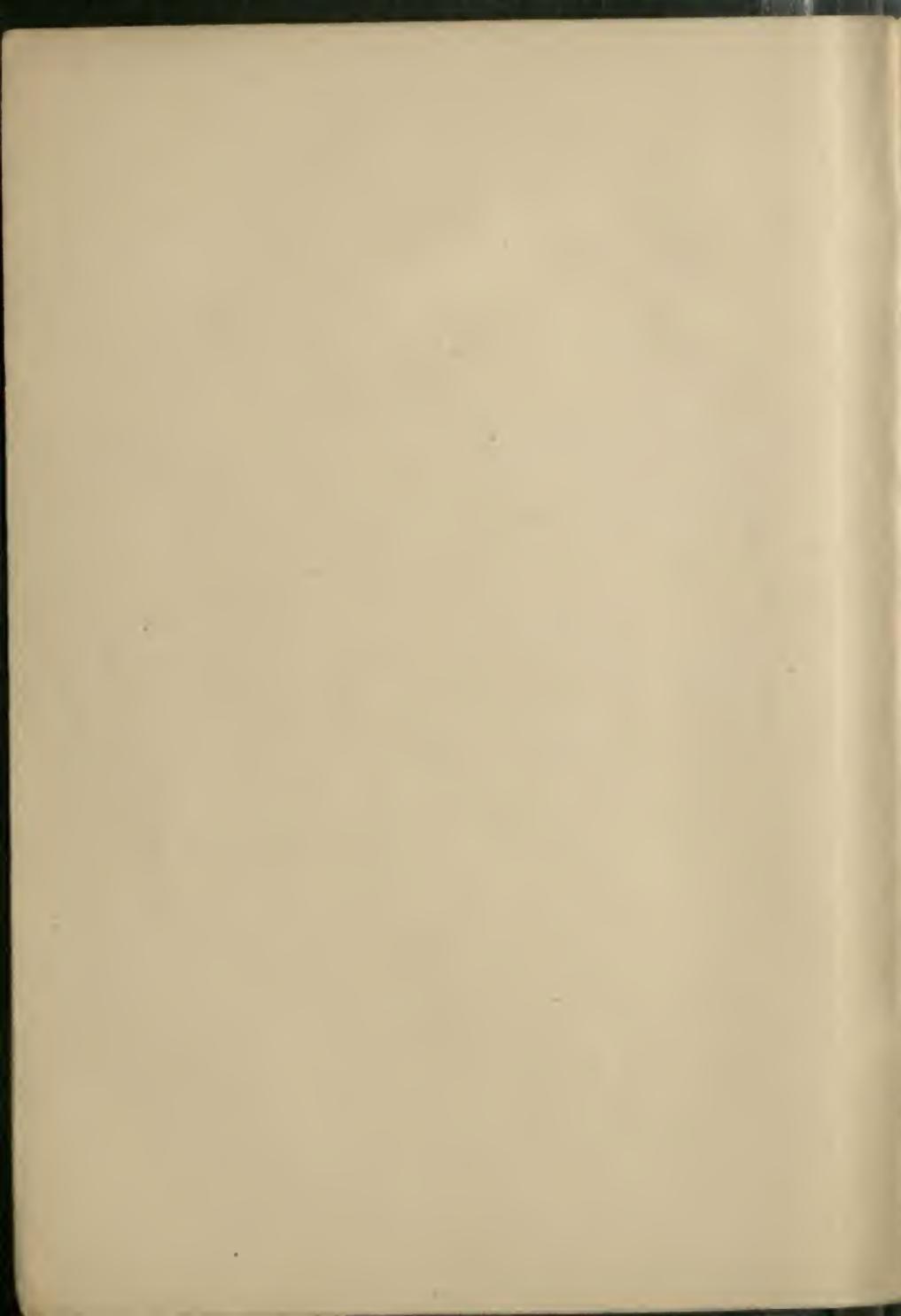
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AUTHOR OF "THE PIANO: HOW TO BUY AND
UNDERSTAND ONE."

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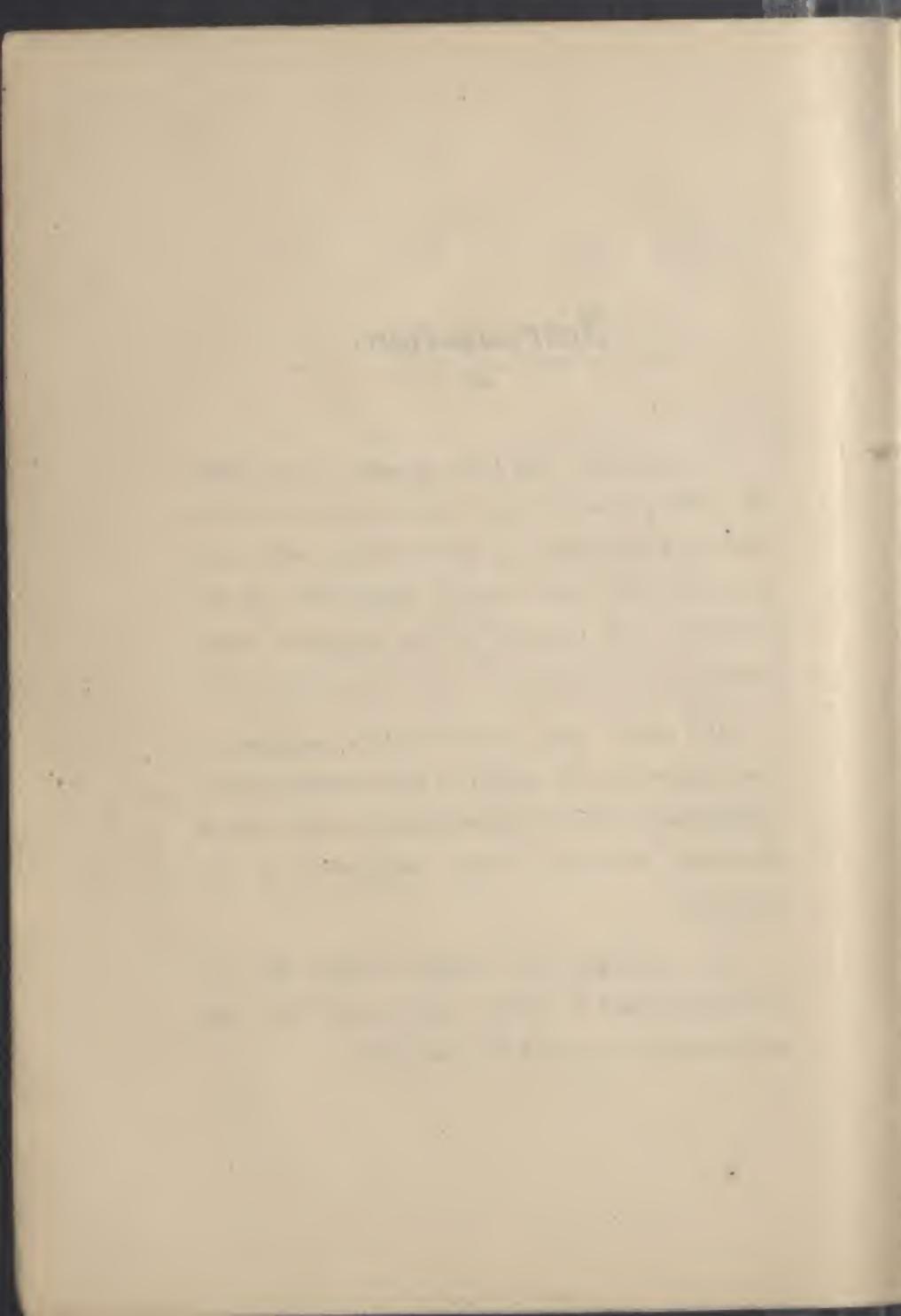
Introduction.



In presenting this little volume to the public, the Author has but one motive—to give to the reader the possibility of understanding, with some amount of ease, the complex mechanism of the pianoforte and methods of its treatment under repair.

He trusts that the information contained in these pages may be useful to those whose musical development may be incomplete through lack of experience with the actual mechanism of the pianoforte.

In conclusion, the Author claims for his book that which is rarely seen—a practical and *not* theoretical work on the pianoforte.



The Anatomy of the Piano.

The Back,

OR FRAME OF THE PIANO.

This consists of five to seven bracings of stout wood at equal distances apart, four or five being uprights, and one at both top and bottom. They are mortised and glued.

The Bentside.

This is a thick piece of wood laid across the bracings at an angle, being either screwed or bolted through them, into which hitch pins are fixed, if an iron frame is not to be inserted. Sometimes an iron plate, called a bentside plate, is fixed upon the bentside, to which the hitch pins are riveted. This is simply to support the bentside and must not be mistaken for an iron frame.

Wrest Plank.

This is a block of beech wood, cross grained, which is either shouldered or laid across the bracing at the top on the inner side of frame. Holes are drilled in this to receive the wrest pins. A thin layer of wood, which is called the facing or capping, is glued over the front of the plank. Holes are bored above the wrest pins in the plank for bolts

or screws to be inserted to enable the wrest plank to bear the strain.

The Bridges.

Of these there are two, viz., top bridge and bottom bridge. According to the nature of the piano, so does the top bridge vary in its construction, the bottom bridge simply varying in so far as in an iron frame it consists of three separate parts, but in the wooden frame consisting of only two. The bottom bridge is both glued and screwed into the sound board, the screws being inserted from the back.

In some pianos a brass pressure bar takes the place of the wooden top bridge and pins. The advantage of this is that it is not so liable to split, and the strings are held more firmly. Separate stud bridges called agraffes are used sometimes for each note, the strings passing through holes made for the purpose.

Sound Board or Belly.

This is composed of boards (usually Swiss pine or fir) neatly joined together and barred at the back by long strips of wood, which are either screwed or glued, sometimes both. This is done to strengthen the sound board, so that it will stand against the strain brought to bear upon it. Much depends upon the manner in which the boards are cut, joined and barred as to the ultimate results attained. Some are joined straight across, others on the slant, which produces a much purer tone and less likely to buckle or give way; the grain should be close and fine; there are three distinct kinds of shaped sound boards, and are

relative to either the vertical, oblique, or overstrung. A beading of wood is glued all round the back of the sound board, it is then screwed on to the bracing of the frame, with bottom bridge attached.

The Iron Frame.

We have now to deal with the Iron Frame, of which there are six distinct forms, irrespective of two other patent frames, of which we shall treat later. To individualise the above-mentioned six forms, they are as follows:—

No. 1. The complete overstrung, *i.e.*, a solid frame from top to bottom.

No. 2. The semi overstrung, extending from the bottom to the edge of wrest plank, and resting on the same.

No. 3. The oblique form from top to bottom.

No. 4. The semi oblique, which, like the semi overstrung, extends to the edge of wrest plank.

No. 5. Complete or full iron frame extending from top to bottom.

No. 6. Frame (iron), extending only from bottom to edge of wrest plank.

It must be understood that many iron frames may possess a plank bar (this is of iron), which is bolted along the top of the wrest plank. Some also have either a brass or an iron pin plate, in which the holes are bored to receive the wrest pins. Each of the above are additions, and quite separate from the iron frame itself. The iron frame is quite free from contact with sound board, but is bolted to the bracings, top and bottom. It must be observed

that in all iron frames there is what is termed a break in the scale, which necessitates the use of three distinct bridges. The reason of this is that there are two supporting uprights cast in the iron frame, causing a division on the bottom bar, and in the case of a full iron frame on the top bar also. The finish of all iron frames is either japan or bronze.

We will now deal with the two patents mentioned before, relative to a special form of iron frame. The first is the Patent Strong Hold, which is cast in one piece, having no wooden wrest plank, and no wooden bridge or pressure bar. The holes are bored in the frame itself at a proper distance from the top to receive wrest pins. The overstrung or oblique forms of the above patent frame are really fine instruments, and can be highly recommended.

The second is the Invisible Iron Frame which is fixed behind the back of sound board, between the back bracings. The drawback to this form will be found in the fact that it is impossible to tell from a casual observance that it is an iron frame. To decide this, it would be necessary to examine from the back. The original idea of the above patent was to obtain a true scale without breaks.

The next thing to consider is the method of affixing the strings. The frame is laid on its back upon trestles. The wire is coiled round the wrest pin, the end having been first passed through the small hole in the head of the pin. The pin is now driven into the plank. The wire is then drawn down to the hitch pin around which it is passed, rising from thence to the wrest plank. Cut off, leaving sufficient spare length to coil and pass

through the head of the pin, as in the previous case. In drawing the wire from wrest plank and hitch pins and returning again to wrest plank the string is carefully placed between the pins on bridges relative to the wrest pin and hitch pin. The whole of the strings are treated in this way, with exception of the bass strings, which are ever single strings and are covered with fine copper wire to give greater depth to the tone of the string. The steel strings are of different thicknesses, the thinnest being at the treble end of the piano increasing in thickness towards the bass. List cloth is threaded between the strings above and below the top and bottom bridges to prevent jarring. The three methods of stringing are: firstly, the overstrung in which the bass strings are stretched crosswise over the rest; secondly, the oblique, wherein all strings are aslant to give somewhat greater length than in the third method, viz., the vertical in which the strings are straight throughout. We now come to case making.

There are many branches of trade relative to this matter, but to individualise them and place them somewhat in proper rotation we commence with:—The back maker, who makes the frame having the bracings. The next in order is the belly-man, who makes the sound board. Then comes the marker off, who marks off the bridges and makes the same and pins them, he also marks off wrest planks and inserts iron frames. The stringer follows and strings the instrument, rough tunes and tapes it. The case or part maker, who makes all parts of case work, including side cheeks, key bottom, bottom board and trusses, top and bottom doors, fall and hollow. Now follows the

fitter-up, who fits part of the case work together, ready for—the finisher, whose business is to build up the action after placing the key frame with keys into position. The action must, of course, be adjusted to a nicety, which is the duties of the regulator. Then the fly finisher comes upon the scene to fit up the back lining or wire backing, falls, doors, both top and bottom. Then comes the toner and tuner, who tones the hammers and tunes the piano throughout. Then the polisher finishes the instrument. The making of the action and keys are both the work of separate men. The action maker only makes the mechanism of the action as the key-maker makes the keys.

The perfection of the modern piano rests upon the fact that every man is really skilled in his particular department through years of practice. A pianoforte factory has no use for a jack-of-all-trades.

Explanation of Case Work.

ACTION AND KEYS.

Firstly. The side ends of case must be glued on to the back. Then the cheeks must be screwed to the inside ends of case, but in some pianos they are doweled and glued. Now, the key bottom which supports the key frame pins and keys, must be doweled and glued to the cheeks. Then the bottom board is either glued or screwed to back and sides. The pedal rockers are then screwed near to the centre of the bottom board, upon which the pedal sticks are glued, which in turn operate either to

damp the tone, as in the case of the celeste, or raise the dampers clear from the strings, allowing full volume of vibration, as in the case of the Forte pedal. It will perhaps be well for us here to explain how the pedal celeste affects the tone to the softening of it on pressing the pedal. Running upwards at the side of the piano is a rod, which we have already referred to as a pedal stick, this is caused to rise upon the pressure being applied to the pedal. Upon this is glued a thin strip of wood, on which in turn is glued a strip of cloth. When the pedal is pressed downwards, the pedal rocker responds and acting as a lever raises the pedal stick, which, lifting the thin strip of wood to which is attached the strip of cloth, brings it just in front of the hammers, causing them to strike, not upon the bare strings, but upon the cloth, thereby softening the tone. The pedal forte simply lifts *en masse* the dampers of the action, leaving the strings free to vibrate even after the key has been released.

THE ACTION,

Which may be an under damper or an over damper, is now put in position, and all parts have to be carefully adjusted and regulated to the greatest nicety, such as the affixing of the hammer-head upon its shank, which in turn has to be glued into the butt. Actions may be either a tape action or spring and loop. Check springs are hooked on to the loops attached to the hammer butts. In the over damper action the damper rail is screwed on to standards at each side of action. The damper wires are put into the damper levers and then fixed into the socket arms below. The front escapement is a

long thin rail upon which are fixed the set off buttons which regulate the striking power of the hammers. The tape action will be fully explained further on in this work. The toe blocks are dowelled and glued to the bracings at the bottom of the frame at each side. The castors are screwed on to the bottom of toes, and the back of frame. The key frame is screwed on to the key bottom at the side and centre. The keys are loaded with round pieces of lead to balance them when touched, and mortise holes are bored in the keys, the key is then centred upon key pins which are fixed in the balance rail, the keys are generally numbered from 1 to 85. The key frame is in three parts: the front rail contains pins with large round baize washers; the centre or balance rail contains the key pins with small cloth washers; the back touch has glued upon it a strip of green baize cloth. The keys are now placed in their proper position. Small blocks of wood are glued at each side for standards for the action to rest upon.

THE NAME BOARD

Is a piece of polished wood covered on the underside with a strip of cloth, and extends right across the keyboard at the back of the keys. This is sometimes screwed to the hollow of fall, or sometimes screwed on to end blocks at each side.

THE HOLLOW

Is held by a grove at each end of cheeks and contains two holes to support the top door.

THE FALL.

Which goes over the keys, is held by a long brass hinge screwed on to the hollow.

The top door or panel front which covers the action from view is now placed in position; the centre may be inlaid with marquetry, carved, gold lined incised, with moulding screwed on to panel, making two or three compartments. Sconces are placed at each side, the pilasters are screwed on the extreme end of panel. The music turnover desk is screwed on the top of centre panel.

THE SOLID LID

is held by two small hinges screwed to the back.

THE HALF TOP.

One half of this is glued to the back having a long brass hinge running through the centre between each part, this renders it a half top.

THE BOTTOM DOOR OR PANEL

Is fixed under the key board, resting on the plinth, held in place by two small dowels. When in position it is fastened by two props or buttons at each side.

TRUSSES.

These are fixed by screwing through the key bottom and under the toes. There are various designs.

Most pianos are numbered, the number is either over the wrest plank, on the bridges or the inside of case ends. To trace the actual manufacturer would be a difficult matter. Very few pianos are of solid choice woods throughout, most being veneered with the woods required, such as walnut, rosewood, mahogany, etc., or can be furnished in black.

For fine construction and finish the German pianos hold their own, but for keeping their quality of tone the English piano cannot be excelled.

To take out the various parts of the Piano.

Lift top lid placing prop in position to support the same, should this be missing a book will suffice to keep the lid open. Next close the fall, release the inside buttons or catches which hold the top door in place, then grasping the panel by the top, with both hands pull the same gently forward, then raising it, it will be found free to be removed. Now grasp the hollow and fall, and lift so that it slides up the grooves in the cheeks. It must be noted that in many old pianos the hollow and fall must be brought forward instead of raised. The name board must now be removed unless it should happen to be screwed to hollow and fall, the whole of the action including the keys will now be entirely free to be manipulated in any manner desired. By releasing the button or catches which are fixed on to the standards for the purpose of holding action in place, the action can be taken out. To accomplish this safely and without danger to the delicate mechanism, grasp firmly the hammer rest rail with both hands, pull it forward slightly, then raise, and it will come out without difficulty. In some actions it will be necessary to place one hand on damper rail, the other holding hammer rest rail, and as a rule the right-hand end of action will have to come out first. This method will be found the easiest and most satisfactory, reducing as it does to a minimum the risk of damaging the delicate construction. If the standards are of iron the bolts must be released before action can be taken out. In many German pianos the action and key board being in one, the screws, both in centre and ends of key frame, must

be removed before the action can be released. In some pianos the screws are under the key bottom.

TO REMOVE KEYS.

Raise the front of key first, then you will be able to grasp the centre, which do firmly, then lift up bodily, the key will then easily be removed. With a sticker action draw the hopper away from bottom lever, then raise as directed. The next to remove is the celeste pedal. This is done by lifting it from pedal sticks (unscrewing if screwed) and it is best to remove one end first, this will render it easier to take out, the right-hand end is the first to remove. To take out bottom panel or door, release props at each side of the door, it can then be removed with ease.

Tools for Repairing, Regulating & Tuning.

Toning needles, fitted with handles used for softening the felt of hammer heads.

Felt knives, for cutting felt.

Wedging chisels, screw drivers, gimlet.

Stuffer, for pushing hinge in grove of sticker.

Nut key, for nutting bolts.

Head setter, for damper heads, setting, etc.

Key spacer, for spacing out keys.

Hammer shank extractor, to get broken shanks out of butt or hammer heads.

Centre bit or twist, for ditto purpose, the twist is the best.

Casting iron tongs, for turning hammer heads.

Bradawl, glue pot.

Wrest pin extractor, to fit tuning hammer, for taking out broken wrest pins.

Coil lifter, for coiling wire close round the wrest pin.

Steel washer punches, small and large, for cutting out baize and cloth washers for keys.

Wire stretcher, used for stretching strings.

Hinge saw, for getting out vellum and hinge of sticker, damper and levers.

Key files, used for filing mortise holes of keys when sticking.

Tweezers, with file edge.

Piano wire guage, for guaging the size of strings.

Pliers, long nose flat, for regulating and putting check springs on the loop cords.

Pliers, round nose, for making springs.

Pliers, for cutting steel wire.

Iron clamps, for holding together glued portions of wood work.

Hammer covering springs, the ratchet, flat or wire spring, for holding the felt or hammers when covering the same.

Long action regulator, for regulating hoppers, pins, buttons or set off buttons.

Eye twiste, for regulating set off pins.

Check bender, for use with check wire, also for stretching strings if required.

Sticker hook, for forcing sticker hinge on to butt notch.

Broaches (wire), used for centre of butts.

ACCESSORIES.

T-shaped tuning hammer, for oblong wrest pins.

" " " square "

" " " star "

These can all be obtained to fit in one handle.

Lever tuning hammer, bent shape, for oblong wrest pins; for square wrest pins; for star wrest pins.

Tuning wedges, cane, padded each end or spring wedge, automatically adaptable for damping wire while tuning.

Grand wedge, for grand piano only.

MATERIALS—CLOTHS.

Back lining, to place at back of piano.

Green baize, for back of key frame.

Box cloth, for key washers of centre or balance rail.

Green baize, for front rail.

 " for hammer rest rail.

Cloth drab, for putting over pilot screws on the end of the key of carriage.

Tape ties, used for check wires.

Hammer felt, for re-covering hammers one length—one set.

Name board cloth, glued on name board.

Check felt, for covering checks.

List cloth, for threading between strings.

Pedal felt, in strip for celeste pedal.

Fawn skin, leather used for sticker hinges.

Doeskin leather, for levers (bottom).

Leather, used for checks and hammer butts (check action).

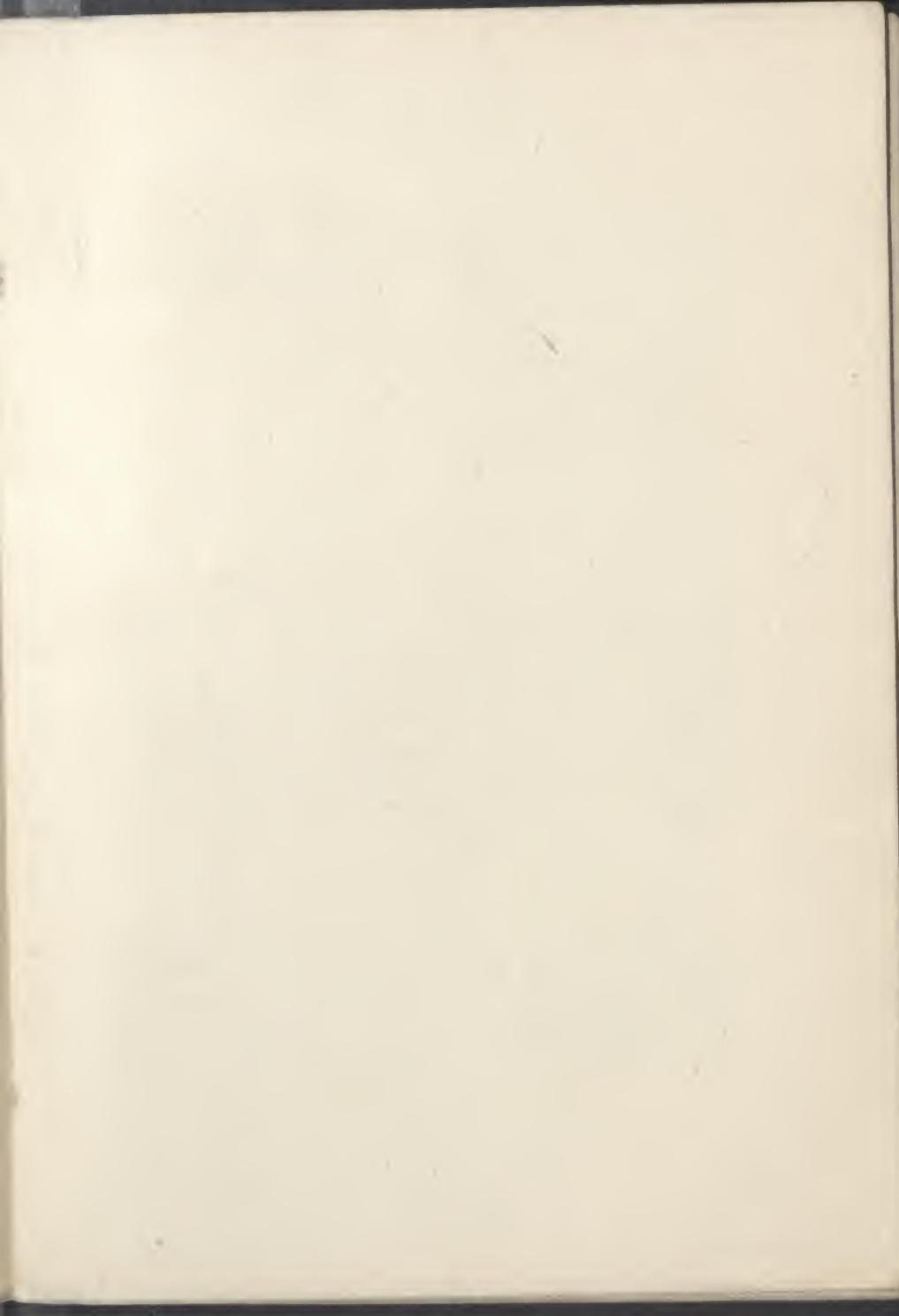
Vellum, parchment for hinges of levers, dampers and hoppers.

MATERIALS (CONTINUED), WIRES, &c.

Iron plates, pinned, for bentside.

Iron plates, for bottom.

Screws, brass or iron, round, square or flat edge.
Pedal feet, iron or wood.
Pedal bosses, for toes of pedals.
Pedal hooks, for working pedals.
Pedal springs, for returning rocker to place after releasing pedal.
Key pins, used for key frame and are oval or round in shape.
Panel pins, for holding doors in position.
Lock and keys.
Hitch pins, for bentside.
Bridge pins, for the bridges.
Centre wire, for hammer butts of sticker action.
Centre pins, for butts and all flanges of different thicknesses used in check actions.
Check or jack springs, must be made to pattern.
Spiral springs, for use with check actions.
Hopper springs, made to pattern.
Damper wires, for check or sticker action.
Damper spoons, for under damper, check action.
Brass action buttons, for fixing action.
Tape wires, to attach to tape ties.
Wooden buttons, to fasten panels.
Hooks and eyes, " "
Hopper pins, for button and cloth.
Music or book holders, for keeping music slipping from rest.
Wrest pins, for re-pinning the piano, per set, different sizes.
Steel wire, for stringing the piano.
Plated steel wire, " "
Coppered " "
Brass wire, for making springs.
Copper covered wire, for bass strings.



Names of Numbered Parts of the Illustration.



No. 1—*The Wrest Plank.*

„ 2— „ *Tuning Wrest Pins.*

„ 3— „ *Steel Strings.*

„ 4— „ *Top Bridge with Bridge Pins.*

„ 5— „ *Sound Board.*

„ 6— „ *Iron Frame.*

„ 7— „ *Dampers.*

No. 8—*The Hammers.*

„ 9— „ *Checks.*

„ 10— „ *Keyboard.*

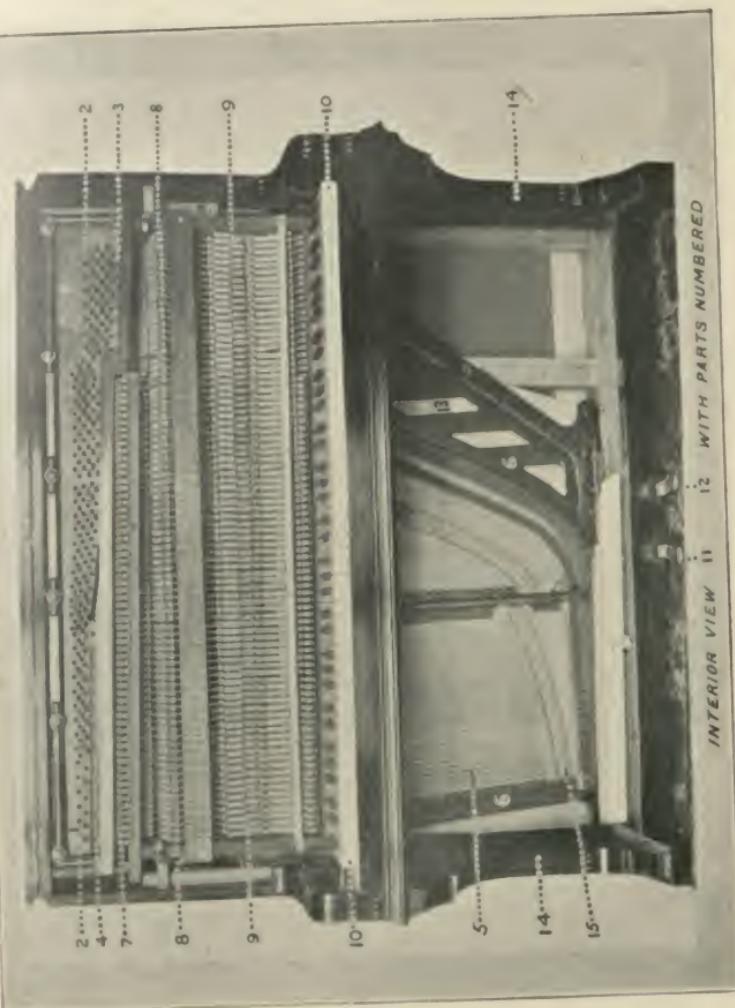
„ 11— „ *Soft Pedal.*

„ 12— „ *Loud Pedal.*

„ 13— „ *Bent Side.*

„ 14— „ *Trusses.*

No. 15—*The Bottom Bridge.*



Specification:—Iron Frame, Full Trichord, Over-Damper Check Action, with Bronzed Iron Bar along the top of the Wrest Plank.

Ivory heads and tails, for keys.
Ivory and slips, for keys.
Ivory and slips, both in celuloid, for keys.
Bolts, for wrest plank and bentside.
Screws, for flanges of action.
Castors, for bottom.
Blacklead, in preference to oil or grease.
Seccotine, for repairing, an adhesive.
Mendine "

The Tuning of Pianos.

The only necessary requirement in this branch are a pitch pipe or tuning fork, whichever preferred, and of course the tuning hammer and wedge already mentioned in the catalogue of accessories, the pipe or fork usually being used for either middle C or A. There are three recognised standards of pitch, the normal being the lowest, the standard somewhat higher, and the concert or philharmonic, which is the highest. The tuner can raise or lower the pitch of piano if required, even above or below the above mentioned extremes. If the tuner simply tunes the piano to the pitch of the middle C, as he finds it, regardless as to whether it is correct to any standard. This is called smoothing the piano. The first thing to do in commencing to tune is to "lay in the bearings," which is as follows:—You first tune your middle C to the standard of pitch required, to this you then tune G below which is a fourth, this must be a wave flat. Now tune the upper D to G, the D in this case also being a shade flat; the A below is now tuned to D, which is a fourth, this must possess a —— degree of flatness. Next follow A to E, this must be tuned

perfect; then from E to B below, a fourth, the B herein being slightly flat. Next from B to F sharp below, the F being slightly flat; then from F sharp to C sharp, a fifth, this is tuned perfect; now from C sharp to G sharp, a fourth, the G being slightly flat; G sharp to D sharp follows, a fifth, tuned perfect; next follows D sharp to B flat below, the B herein being a shade flat; then B flat to F, a fifth, tuned perfect; then from F to F lower, this must be tuned perfect, and is called the unison or octave. We may now consider the ground work of the scale laid in; the rest may now be tuned either by fourths and fifths, called the short method, or by octaves or unisons, which is the long method; the latter is much the best method for beginners. From the foundation the treble should be tuned first, the bass being left till last; it is well to repeat this two or three times to be certain as to its correctness.

In tuning it is wise, now and then, during the process, to make use of a few trial chords such as G C E, A C sharp E and F A C, etc.

TUNING—*MODUS OPERANDI.*

First of all examine wrest pins to see the kind of hammer required. If the piano contains a celeste it is best if possible to remove this, you will be better able both to hear and have access to the wires. Selecting the correct pin relative to the string about to be tuned, place your tuning hammer firmly in position; by looking over the damper rail it will be easy to see if you are on the right wrest pin; the proper method of holding the hammer is to fold the fingers over **T** piece, the thumb resting beneath and at the end, this gives to the hand great leverage and

minimises any strain upon the wrest pin. Do not bear down upon the wrest pin. In tuning a bichord or trichord piano (*i.e.*, two or three strings) a wedge is used to deaden the extra strings, while the one receiving attention is being tuned. It must be placed below hammerhead between the shanks, and resting upon the hammer rest rail, to avoid the hammer catching it as it strikes the string, place the wedge between shanks two hammers higher than one being used, when string is tuned, replace wedge one wire higher to enable you to tune the relative string to the one already tuned. In the case of a trichord, repeat this again, you will then have completed the note, this method must be used throughout; to sharpen note turn hammer to the right, to flatten, the reverse. Turn hammer slowly to avoid if possible breaking any strings.

TO SET WREST PINS.

The best method of accomplishing this is to turn the hammer carefully, at the same time striking the key firmly. Should the wrest pin turn too easily, gently tap it into the wrest plank with tuning hammer, should it still be weak it will probably be found too small, and must be removed, a more suitable one put into its place; the secret of becoming a successful tuner is by continual practice; the ear is apt to tire from constant listening, therefore it is as well to occasionally rest during the process.

Regulating Pianos.

THE STICKER ACTION.

There are various methods of regulating, viz., first, by altering the touch of key by carding, which

is the placing of round pieces of paper under the green baize of key pin, this causes the hammer to come away from the strings quicker.

Secondly, by flattening the baize washers by hammering, this renders the touch deeper, the baize being thinner.

Thirdly, by placing pieces of thin cartridge paper under the front rail of the key board at each end and centre, this will render the touch of the key more shallow.

Fourthly, by raising the small screws upon the block, which will be found glued upon the key bottom at each end, upon which the standards of the action rest, will regulate the striking distance of the hammers. The fault termed "blocking" is a tendency for the hammer to remain on the string after being struck, this, of course, should not be, as the tone is deadened and killed, therefore to rectify this the hoppers must be regulated, which is accomplished as follows: the hopper pin must be turned to the left, this causes the hoppers to recede, thereby freeing the hammers from the strings. If, as is sometimes the case, the button is on the end of the hopper pin, then it is turned to the right instead of the left. If necessary, on the other hand, by turning the hopper pin or set off to the right, the hopper then goes further under the bottom lever, this can be adjusted accordingly.

CHECK ACTION.

In an action in which the tape brings the hammers back after striking the strings, the check always strikes against the front of counter or balance hammer, which is a short stem glued on to the

hammer butt, to regulate this the check wire must be pulled forward. In a spring and loop the check strikes the back of the balance hammer, to regulate this the check wires must be put back, this releases hammers from strings, this can also be accomplished by turning down the screw on the carriage of the key under the box cloth, also by turning the pilot on the end of keys, either to right or left as required, will raise or lower the same.

TO REGULATE ESCAPEMENTS OR SET-OFF PIN AND BUTTON.

There is the front escapement, the centre, and the back. To regulate these turn the hopper pin to the right, this lowers the hopper pin, this refers to the front and centre, and frees the hammer from the strings. The back is regulated by turning the hopper pin to right or left, to regulate the jacks.

KEYS.

All keys must be perfectly level, should some be too high, alter washers as required. If one key is below the others, place thin washer on key pin of balance rail.

TO REGULATE PEDALS AND DAMPERS.

Should vibration continue after the release of key, it must be rectified by withdrawing screw at top of damper rail at the treble end of piano and setting it slightly back, this will bring the dampers within range of the strings. Each damper must cover the strings to damp perfectly. In a sticker action by turning the damper buttons attached to damper wires downwards, the same effect will be

produced. In check actions lift the damper wire from socket arm, then turn small button to left, which will lower it on the wire, then replace as before.

By thinning or altogether removing blocks from pedals will give greater freedom to the action of the dampers, rendering their operation more certain and with better effect.

Repairing.

WOODEN WREST PLANK.

The first thing to do relative to this is to remove capping, this enables you to see whether the plank has come away from the back, or if it is split beyond repair, then let down all strings, this must be done at different places to equalise the strain. Now if the wrest plank has merely come away from the back, you proceed to drill holes through the plank, into which bolts are placed, and by nuts these are drawn up tightly, thus drawing the wrest plank up to the back, a little glue is placed between the joint, screws are then inserted to assist in bearing the strain; the split wrest plank calls for the skilful and expert man, being a much more difficult task, and in many cases it would be cheaper to have a new plank altogether, allowing of course, that the piano is a good one and worthy the expense.

THE BENTSIDE.

If through too great a strain the bentside leaves the bracings, an iron plate, with hitch pins attached, and holes bored therein for screws, is procured; this is then firmly screwed to the bracings, and the repair

is complete; to procure the plate a pattern of the bentside is taken on paper by a rubbing of heel ball; this ensures the proper localising of the hitch pins and bolts.

BRIDGES.

Should one be split in a small part only and not straight across, with a good saw cut through each side of split, and, prizing it up with a chisel, remove it, being careful not to injure the plank; a pattern of the bridge is then taken with the aid of heel ball, which pattern is sent to a vendor of fittings. When putting on the new bridge glue it to the plank, also inserting screws; when bridge is fixed, level the bridge pins. In the case of the bottom bridge, remove them by simply taking out screws at the back of sound board and remove bridge; the new bridge is then glued into position and again screwed from the back.

THE SOUND BOARD.

Should the sound board be cracked, it can be remedied by a thin wedge glued in the aperture. This is really the parting of the joints. If cracked in various places a new sound board is advisable, always allowing the instrument to be worth the expense. To remove the sound board the strings must be taken off and all screws removed, it must then be gently forced off; in the case of an iron frame, it would have to be removed.

TO STRING A PIANO.

Having made a thorough examination and discovered the piano to be sound throughout and fit for stringing, you first remove all old strings, then

the wrest pins must be removed and new pins of a larger size put in their place. There are about ten different degrees of strings, from 13 to 22 inclusive, and usually eight notes to a degree up to 18, then about four notes to a degree, this of course does not refer to the covered bass strings, which are made to pattern; to remove strings place hammer firmly upon wrest pin, then, holding string in the left hand, turn wrest pin to the left, pulling hard upon the wire while turning. This will uncoil the string from head of wrest pin, now remove it from bridges and hitch pin. If new wrest pins are required, they must be first gently tapped into the plank, and then turned until they are in the necessary distance, a little chalk is first rubbed on the end of the pin, this makes the pin turn easy and smooth. The piano can be strung on its back or upright, the above method of stringing refers to the upright position. It is always well to leave one of the old wrest pins in as a guide to depth. Strings can be had either plated or coppered, and obtained in quarter pound hanks. In the case of being singly strung it is necessary to make a loop, this is done by bending the wire into a loop, then coiling the end strand around main wire several times. The string is coiled three times upon the wrest pin, and must also be well rubbed down and stretched, or it will not keep in tune.

TO REMOVE BROKEN WREST PINS.

First place a round baize washer over pin to protect plank, then screw the extractor (which cuts a left-handed thread) on the end of wrest pin, and gently turn it out.

Actions.

STICKER.

It must first be explained that in this action the damper rail is always above the hammers, and is called the over damper action, the damper wires pass through socket holes in the lever, and are fixed by buttons being screwed on the projecting end and in some cases also beneath the lever, in others the rail is quite separate, one button only being used at the top, and is called the socket rail.

TO RE-COVER DAMPERS.

In the action where the wires pass through the sockets in the levers, and are buttoned, the buttons (top) must be removed before the damper rail can be taken out. The old felt is first removed from the damper heads, the glue being well cleaned off by the use of glass paper, then neatly cut new strips to pattern with a sharp felt knife, should undercloth be worn, replace same by glueing new material, then glue felt exactly in centre, great care being taken in putting it in centre of damper; it is imperative that they should be perfectly even and level.

DAMPER LEVERS.

Levers work by hinges composed of parchment, the lever flange may be glued or screwed on the damper rail, these flanges must of course be removed before any repair, if required, can be made, therefore in the first case where it is glued it is loosened at the sides with flat jawed pliers. In the second case the method of removal is obvious. Should any of these hinges be broken you proceed as follows:—

With a knife or saw remove the old vellum by inserting one or the other in the slot in which the broken part of the vellum remains, and with new vellum you make another hinge according to pattern, this must be scraped before glueing, owing to its greasy nature. One part is placed in the flange, the other in the lever, both being drawn close, then left to dry. The working portion of hinge must be quite free from glue, when dry screw or glue damper flange on rail. The foregoing refers only to over damper actions, under damper actions not having the hinge.

DAMPER WIRES.

To replace these you remove them from the stickers, to do this you will first remove the button, then pull wire from the socket and remove the lower end from sticker and insert new wire. In some cases it is necessary to remove hammer rest rail, owing to the wires being under it. New buttons and cloth can be placed on wires if necessary.

SOCKET RAIL.

To re-bush this all buttons must be removed from wires, the nuts must next be taken off the stays, the socket rail can then be lifted off the wires, remove the old bushing, cleaning off the glue with glasspaper. Now procure a strip of bushing cloth, one end of which is pointed, insert the pointed end through socket hole, then draw it right through sufficiently to curve round the socket, having first glued it slightly, cut off the under part with sharp knife, leaving the glued portion in the socket hole.

HAMMERS.

To re-cover hammers remove hammer rail as previously directed, if damper rail is separate from the action, it need not be removed. In some cases the damper rail must be removed to get damper wires out to have easier access to hammers. In the case of the damper wires being free from the levers, all that is necessary is to remove nuts from stays and lift socket rail, then draw it forward clear of the hammers, keep hammers firm with a long thin strip of wood tied upon the hammer rest rail, remove old covering from the hammer (this refers to the outside layer only), with sharp felt knife, then with the thickest and thinnest felt as a pattern for the length and size, cut your set of hammer felt into strips as per pattern, allowing for the stretching of the felt around hammer head, clean off the old glue, then glue half way under the top of each head, but not the points which strike the strings. Then put on wire hammer spring to hold felt in place till dry, after which pull felt tightly over the hammer head, glue same as before, place the spring on again till set, and then trim hammer sides with felt knife.

HAMMER SHANKS.

To repair these the action must be removed, with pliers break off the portions of the shank close to both hammer head and butt, now with twisted centre-bit bore hole to receive new shank, holding hammer head or butt firmly to avoid splitting. The exact length of new shank must be noted, allowing sufficient excess to insert both head and butt, file each end slightly pointed, then dip into glue and insert. When this is accomplished the repaired

hammer should be level and equal in all respects to the rest.

HAMMER BUTTS.

In repairing hammer butts, no matter whether the whole of the butts are on one centre wire or in sections, the butts in either case must be removed, that is, such as are in the way of that one needing repair. The butt must be procured to pattern and replaced. To re-bush the above, remove stickers from bottom levers by inserting a small knife or chisel under the sticker. Then remove hammer butt from wire. A set of bushing cloth can be obtained ready for use, take out old bushing and clean holes, put point of new bushing into the holes, pulling it through, tip the end with a little glue, then draw right through sufficiently to curve round socket and when set, cut and trim and run a thin wire through the hole ready for centre wire.

STICKER HINGES.

To repair these, take a pair of pliers, pull off the old hinge from hammer butt notch, using a fine saw to clean out the sticker groove. Procure a set of fawn skin, cut the same width as groove, the length should be about half-inch, this is then doubled with pliers, making one part slightly longer, insert a little glue in groove, place the bend of the hinge firmly in the groove, the longest piece being in the front. When set, re-hang hinge on hammer butt notch, then re-glue sticker on the lever.

BOTTOM LEVERS.

To recover the levers, first remove the old buff or doe skin and clean the surface, then procure a

new set of buff and cut pieces to pattern as previously explained, glue one end *i.e.*, the under part of lever, then attach buff and fix spring to hold it in position, when set draw buff tightly round nose of lever, glueing top and placing spring to keep it fast. The vellum hinge of lever is repaired in precisely the same manner as the damper hinge.

CHECK ACTIONS.

In check actions the vellum hinges or flanges are replaced by centre pins, if these are loose and work out, a size larger pin must be inserted in their place, this is called "re-centreing." Care should be taken not to injure bushing of flange when inserting new centre pin.

HAMMERS.

Hammers in an action in which the felt is pinned or riveted upon the hammer heads are machine made, but they can be re-covered as per method already explained *re* the sticker action. If desired, a new set of hammers can be obtained to pattern if required. To remove hammers from shanks, heat the nose of flat pliers, holding the hammer head until the glue is loosened around the shank, and the head can then be easily removed. The new hammers can now be placed upon the shank as before; one or two hammers must be left in as a guide to height.

TONING THE HAMMERS.

Toning hammers is merely to slightly pierce the felt on the head of the hammer, this softens the felt, rendering the tone mellow, and must be

manipulated with caution, as it may very easily be over done. The hammer head should be held very firmly, and with the toning needles slightly pierce the striking point of the felt first, also at the sides, if necessary, testing it during the process with another note until correct, the felt must not be raised from the hammer head too much. Should the toning process be carried too far, it can be rectified by heating the hammer head with a hot iron, but it is advisable not to resort to this, as the result is never satisfactory.

RE-COVERING BUTT NOTCHES AND CUSHIONS.

First unhook the spring from the loop, or, if tapes, lift them from tape wire, then unscrew flange, the hammer and butt may now be removed; take the old cloth from notch and cushion, and using this for pattern, cut new set of each and glue them on for notch and cushion.

TO REPLACE LOOP CORD.

With small awl take out the plug that fastens the cord in the butt, bend loop cord to form a loop, pass the two ends through the small hole where plug was taken from, then make a new plug, tipping it with glue, and insert in the hole. The loop must be the exact length as the others, and should the ends protrude they should be trimmed.

INSERTING NEW TAPE TIES.

The tape should first be lifted from tape wire, then unscrew the flange of hammer butt, also remove and unglue small shank of balance hammer in

hammer butt by heating with pliers, insert new tape, and glue shank of balance hammer into position.

RE-COVERING CHECKS.

The old cloth must be removed and a new set of check felt procured, this should be cut into lengths similar to the old pattern, and finally glued upon the checks.

BALANCE HAMMERS.

To re-cover.—First remove the old leather, and, having obtained a new set, then cut to pattern, place a little glue on balance hammer (not leather) and affix. It should be noted that in either leather or cloth, the wood must be glued, and not the material.

THE SET OFF BUTTONS.

A new set of buttons with cloth attached may be obtained ready for screwing on the pins, having purchased these unscrew all stays, and remove set off rail, then take off all loose buttons and screw the new ones on the pins, before re-placing set off rail.

BLACK LEADING.

The following is a good formula for re-blackening any parts that may require lubrication:—Obtain a small piece of wood, to which affix a strip of leather, then damp some lead, and rub it on with rubber where required, after which burnish with a piece of steel; all parts requiring leading must be treated in this manner.

CHECK SPRINGS.

To make these, use round-nosed pliers, gauging for size from broken spring, then make three coils, leaving sufficient spare wire for fixing, at the end of

which you make a hook loop as pattern, which hooks on loop cord; to remove broken portion raise wire from slot with a small awl, then pull it through.

HOPPER SPRINGS.

These are fashioned in the same manner, but minus the hook loop.

SPIRAL SPRINGS

Are used in check actions for tapes, but in these there are seven or eight coils, of equal distance apart, and must be made to pattern, one end of the spring is attached to the check arm, the other end under the jack. All springs can be obtained in sets to pattern if required.

HAMMER REST RAIL.

Should this require re-covering, first unscrew from the standards and remove rail, and then re-cover with baize. In all cases of repairing all parts should be thoroughly cleaned, and the action always placed upon a small bench when repairing. After a repair of any description let your examination of the work be thorough, so that you may be certain that it is relative in every particular to other parts.

Keys.

If the keys of the piano rattle or are in any way loose, the defect may easily be remedied by removing key pin and then re-placing it by another somewhat larger. Should the whole of the keys require re-pinning it will be necessary to remove the key frame, and, having placed it on the bench, leaving one or two keys in as a guide to height and space, the pinning may now be proceeded with. If the keys

are bushed with cloth, it will be necessary to re-bush them, removing the old cloth and re-placing in the usual way. If the keys work tightly the mortise hole should be slightly filed where marked by key pin, or tap the key pin either forward or backward as required. Either of these remedies applied will rectify the evil.

HOPPERS—STICKER ACTION.

New hopper pins, buttons and cloth may be replaced if necessary, or new hoppers, complete to pattern, may be obtained ready for inserting. The old hoppers should be taken out by tapping at the back, whilst the grooves should also be cleaned, next take the measurement of hopper as to the length from the bottom of key to lever and then glue the hopper to key, allowing it to set.

KEY CARRIAGES.

To re-cover these with new box cloth:—First remove the old cloth, and, having cut the new strip according to pattern, glue one end of the key, to which affix one end of the cloth, placing the other end over the screw, but not fastened in any way, thus allowing the cloth to be lifted if required to replace new screws. Should the ivory come apart from the key, the latter and also the ivory must be well cleaned before being glued and fixed. Ivory heads and tails may be obtained according to pattern and colour required, or complete sets can be obtained by sending keys to the maker, who will fix them. To restore the colour of keys, the ivory is first planed, and, having mixed a portion of whiting and spirits of wine, they should be well polished. Any part of an action may be obtained if required.

Advice.

In tuning the piano should a jarring sound be noticed the principal cause will invariably be found as follows:—The washers of bolts which go through wrest plank becoming loose. Loose screws. Pin plate bulging through insufficient screwing. Strings being too close one to another. Copper covering on strings being loose. Sconces and doors being insufficiently secured. Pedal bosses or castors loose. Squeaking may also take place through the black lead having worn away. Clicking may also be caused by the hammer head being loose in its socket.

In tuning, the single notes should be tuned first, thus becoming well practised in rendering the vibrations of the two or three strings relative to the same note, perfect in their concord one with another. When this is accomplished you may then try the unisons or octaves, after which lay in the foundation. Practice, and that alone, coupled with perseverance, can only bring about success in this direction.

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